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DESCRIPTION AND CORRELATION OF THE ROMNEY FORMATION OF MARYLAND.[1]

CONDENSED DESCRIPTION OF THE ROMNEY FORMATION.

THE lower member of the Romney formation in Allegany county is composed principally of fissile black shale, some of which weathers to a yellowish or buff color on long exposure. In comparatively fresh exposures, however, as in the railroad cuts at Twenty-first Bridge, the shales are either black or rusty-brown after some weathering. The black shales are shown to best advantage in these cuts, although on the Williams Road, three and one-half miles southeast of Cumberland, is perhaps the most nearly complete exposure of this division with an approximate thickness of 512 feet. In the lower part of some of these exposures are bands of very dark-colored thin limestone. The lithological characters of these shales agree closely with those of typical exposures of the Marcellus shales in New York state, and in addition they contain such characteristic species as *Liorhynchus limitare* (Vanuxem) and *Agonitaites expansus* (Vanuxem).

The second member of the Romney formation, the Hamilton beds, has an approximate thickness of 1,100 feet, and is composed of shales and sandstones. In recent exposures the shales, generally bluish or bluish-gray in color, vary in composition from quite coarse arenaceous to those that are fine and argillaceous. The sandstones,

[1] Published by permission of Dr. William Bullock Clark, state geologist of Maryland. The data upon which this paper is based will appear in detail in the forthcoming Devonian volume of the Maryland Geological Survey.

which on fresh surface are generally blue or gray in color, are not very coarse in texture, and the layers are often less than a foot thick. All of these rocks, however, on long exposure usually present along the highways a slightly greenish or yellowish-gray tint. There are two prominent sandstone zones in this member of the formation, varying in thickness from about 30 to 75 feet. The lower one is from 500 to 550 feet above the base of this division, or from 1,000 to 1,050 feet above the base of the formation, while the upper zone is at or near the top of the formation. Both of these sandstone zones are clearly shown in the sections on the Williams Road and at Great Cacapon, and the upper one at Gilpin and above Corriganville. The shales in many localities are very fossiliferous, especially those between the two sandstone zones, and contain numerous specimens of such characteristic species of the New York Hamilton as *Spirifer mucronatus* (Conrad), *S. granulosus* (Conrad), *Athyris spiriferoides* (Eaton), *Tropidoleptus carinatus* (Conrad), *Chonetes coronatus* (Conrad), *Phacops rana* (Green), and other species. On account of the presence of numerous Hamilton species together with a lithologic similarity and approximate stratigraphic position, this division of the Romney formation is regarded as equivalent to the Hamilton stage of New York.

The estimates of the thickness of the Romney formation vary from about 1,600 to 1,650 feet. In Allegany county both the Marcellus shale and Hamilton stage are clearly shown; but farther east in Washington county the Marcellus shale or a part of it is wanting. This would indicate that the subsidence of the Onondaga land area began at an earlier date in Allegany than in Washington county.

CORRELATION OF THE MARCELLUS SHALE.

The lithological similarity of the thin, black shales forming the lower part of the Romney formation to the Marcellus shale of New York has been noted in the description of the Romney formation, and in other places in the Maryland volume. This is so marked in connection with its similar stratigraphic position that the northward continuation of these shales in Bedford county, Pennsylvania, were unhesitatingly called the Marcellus by Professor Stevenson in his geological report of that county. Following the northeasterly

strike of the Devonian formations across Pennsylvania, a similar lithologic and stratigraphic shale has been noted by various geologists at different localities, until Monroe county in the northeastern part of the state is reached, where it was positively identified by Dr. I. C. White. The localities in the northeastern part of the state were later studied by the writer, who from the lithologic, stratigraphic, and paleontologic evidence fully accepted Dr. White's correlation.[1] This practically carried the black shale into southeastern New York, where the identification of the black, fissile shale below the Hamilton beds as the Marcellus has not been questioned. Finally, in the Cumberland basin of Maryland Mr. Schuchert positively identifies this shale as "the Marcellus stage of the Middle Devonic," which he states "rests directly upon the eroded Oriskanian."[2]

These shales in general are sparingly fossiliferous in Maryland and northern West Virginia; but there are occasional layers in some localities which contain a more abundant fauna. There may be a question whether the fossiliferous zones noted at certain localities are not stratigraphically above the very fissile bituminous shale so well exposed in the southern part of the Baltimore & Ohio Railroad cut at Twenty-first Bridge, which agrees so strikingly with the Marcellus shale of New York. The writer has studied to some extent the fauna found mainly in the shales which lithologically closely agree with the New York Marcellus. Dr. J. M. Clarke has probably a larger collection, obtained in part from the fossiliferous layers mentioned above, which he is elaborating, and consequently this is to be regarded as only a preliminary account of this fauna.

Twenty-one species have been listed by the writer from these shales, three of which are restricted to Maryland.[3] The other eighteen either occur in New York or are represented by closely affiliated species. These species range in New York from the Schoharie grit to the Chemung, inclusive, and the formations containing the largest number of them, which therefore become the most important in correlation, are as follows: Marcellus, 10 identical, 4 affiliated;

[1] *Bulletin No. 120* (1894), U. S. Geological Survey, p. 4.

[2] *Proceedings of the U. S. National Museum*, Vol. XXVI (1903), p. 422.

[3] Tables giving the geological range and geographical distribution of the Romney species will be published in the Maryland Devonian volume.

Hamilton, 8 identical, 6 affiliated; Sherburne, 2 identical, 3 affiliated; Ithaca, 8 identical, 3 affiliated; and the Chemung, with 3 identical, and 2 affiliated. It will thus be seen that, so far as this fauna is concerned, it indicates the correlation of this shale with the Marcellus shale and Hamilton beds of New York, with the evidence somewhat in favor of the Marcellus, since it contains 10 identical species to 8 in the Hamilton. The weight of evidence in favor of correlation with the Marcellus shale is strengthened when the list is examined a little more closely. *Liorhynchus limitare* (Vanuxem), which, so far as I am aware, is confined to the Marcellus shale in New York, and perhaps may be considered its most characteristic fossil, or at least its most distinctive Brachiopod, is found generally in the black, fissile shale constituting the lower part of the Romney formation in Maryland. *Bactrites aciculatus* (Hall) is known only in the Marcellus of New York, and the *Agoniatites expansus* (Vanuxem) is so characteristic of a thin layer of limestone in the lower Marcellus of New York that it has been named the Agoniatite limestone. In Maryland 170 feet or more above the base of the black shales are thin limestones which also contain *Agoniatites expansus* (Vanuxem).

Finally, it may be said that, so far as the paleontological evidence is concerned, it shows a close relationship between the Maryland black shales and the Hamilton beds of New York, and Dr. John M. Clarke has already shown that such a relation exists in New York, since a large percentage of the species found in the Marcellus shale of that state occurs in its Hamilton beds.[1] The paleontological evidence, however, shows a still closer relationship with the Marcellus shale fauna of New York, which is supported by the visible continuity, lithologic similarity,[2] and stratigraphic position of the containing shales, so that the correlation of this Maryland black shale with the Marcellus shale of New York appears to be fairly well sustained.

CORRELATION OF THE HAMILTON BEDS.

The rocks overlying the Marcellus shale of the Romney formation, and extending northeasterly from northern West Virginia across

[1] *Eighth Annual Report of State Geologist of New York*, 1889, pp. 60, 61.

[2] For a summary of the various methods of correlation see MR. GILBERT in *Compte rendu*, Fifth Session, International Geological Congress, 1893, pp. 151–54.

Maryland and Pennsylvania to New York, have been much more frequently correlated with the Hamilton beds of New York. Professor James Hall and other paleontologists have identified collections of fossils from these rocks in northern West Virginia, and from intermediate localities between that state and New York, as composed of Hamilton species. If the various geological maps, reports, and papers describing the Devonian formations from West Virginia to New York are put together and considered, it will be found that this correlation is strongly supported by visible continuity. Furthermore, the stratigraphic position of these beds strongly supports this correlation.

The paleontological data are as yet much more extensive regarding the Hamilton beds than for the Marcellus shale. The total number of species recorded by the writer from the Hamilton beds of Maryland is 147, of which 21 are limited to Maryland, leaving 126 identical or closely related species which also occur in New York. An enumeration of the totals for the New York Devonian formations shows that 3 identical species occur in the Helderbergian series; 1 identical, in the Oriskany; 6 identical, in the Schoharie; 17 identical, doubtfully 4 more, and 2 affiliated, in the Onondaga; 47 identical, 1 more doubtfully, and 7 affiliated, in the Marcellus; 92 identical and 32 affiliated, in the Hamilton; 2 identical, in the Tully; 4 identical and 1 affiliated, in the Genesee; 2 identical, in the Portage; 4 identical and 2 affiliated, in the Naples; 10 identical and 1 affiliated, in the Sherburne; 55 identical, 2 more doubtfully, and 9 affiliated, in the Ithaca; and 18 identical, 4 more doubtfully, and 3 affiliated, in the Chemung. Adding these numbers, the total number of entries for each New York formation is as follows: Helderbergian series, 3; Oriskany sandstone, 1; Schoharie grit, 6; Onondaga limestone, 23; Marcellus shale, 55; Hamilton beds, 124; Tully limestone, 2; Genesee shale, 5; Portage beds, 2; Naples beds, 6; Sherburne sandstone, 11; Ithaca beds, 66; and the Chemung beds, 25. Judging from the number of entries, it is then seen that the Maryland beds show the closest relationship with the Onondaga, Marcellus, Hamilton, Ithaca, and Chemung formations of New York; and especially with the Marcellus, Hamilton, and Ithaca. On examining the total number of entries for these three formations, it is found that the Marcellus has 44.3 per cent. as

many as the Hamilton, and the Ithaca 52.8 per cent. This is not remarkable, however, when it is recalled, in the first place, that a large percentage of the species in the Marcellus shale of New York continue into the Hamilton beds of that state, as has been shown by Dr. John M. Clarke; and, in the second place, that the Ithaca fauna is sequential to the Hamilton, and in the Ithaca region contains a large percentage of Hamilton species. When followed to the eastward, and after the disappearance of the Tully limestone and Genesee shale in the Chenango valley, the writer has shown that a still larger number of the Hamilton species lived into Ithaca time, although part of them were represented by simply a few individuals which were the last feeble representatives of their species. These rare individuals have been recorded in the range of the species, making the faunas of the Hamilton and Ithaca beds of New York seem more closely related than they actually are; and the same is true regarding the faunas of the Maryland beds and the Ithaca beds of New York. This explanation is sufficient to show that the above tabulation gives full expression to the closeness of the relationship which exists between the fauna of the Maryland beds and the faunas of the Marcellus shale and Ithaca beds of New York, as compared with that which exists between the fauna of the Maryland beds and the New York Hamilton fauna. Restating the tabulation, then, it is shown that there are more than twice as many entries common to the Maryland and New York Hamilton beds than to the Maryland and New York Marcellus; and nearly twice as many for the Maryland and New York Hamilton beds as for the Maryland and New York Ithaca. Therefore the paleontological evidence strongly supports the correlation of the Maryland beds, which represent in general the midddle and upper portions of the Romney formation, with the Hamilton beds of New York.

Recently Professor H. S. Williams has published an extended account of what he calls the *Tropidoleptus carinatus* fauna of the Hamilton formation.[1] Faunally he considers the Hamilton formation as including the deposits between the top of the Onondaga limestone and the base of the Tully limestone of central New York, which

[1] *American Journal of Science*, Fourth Series, Vol. XIII (1902), pp. 421–32; *Bulletin No. 210*, U. S. Geological Survey, 1903, pp. 42–68.

have generally been divided into the Marcellus shale and the Hamilton beds. Professor Williams compiled a list of twelve species for the *Tropidoleptus* fauna which he called the "standard list of dominant species for the New York-Ontario province." Another list was also compiled, which he called a "revised list of dominant species of the Hamilton formation of eastern New York and Pennsylvania, as expressed in 183 faunules," which contained the twelve species given in the standard list and four additional ones. All of these sixteen species occur frequently in the Hamilton beds of Maryland.

Professor Williams, after an examination of the preliminary lists from the Hamilton beds of Maryland, published the following statement:

> In the list furnished me by Professor Prosser there appear 132 entries, 91 of which are positive identifications. Among the latter are found all of the dominant species of the *Tropidoleptus carinatus* fauna, as estimated from the New York statistics. This is sufficient to establish the extension of the *Tropidoleptus* fauna, in its integrity, as far south in the Appalachian trough as Maryland.[1]

Other facts brought out in the Maryland Devonian report by Dr. John M. Clarke and the writer apparently show that the Hamilton beds of Maryland are succeeded by deposits and faunas similar to those succeeding the Hamilton of New York, and therefore it may be concluded that the deposits of the Hamilton beds from New York to West Virginia were brought to a close at about the same geological time.

EUROPEAN EQUIVALENTS.

The early attempts at correlating the Devonian rocks of the United States with those of Europe dealt only with the formations found in New York, which, in fact, has generally been the custom down to the present time. In 1842 Conrad published the statement that "the Ithaca group, Chemung group, and the Old Red Sandstone near Blossburg, in Pennsylvania, constitute the equivalents of the Devonian system as developed in Europe," and contain a number of fossils characteristic of European Devonian strata.[2] The same year Vanuxem stated that the last three groups of the "Erie Division"

[1] *Bulletin No. 210*, U. S. Geological Survey, p. 67.

[2] *Journal of the Academy of Natural Science*, Philadelphia, Vol. VIII, p. 232.

—viz., the Portage, Ithaca, and Chemung—"appear to correspond with the Devonian system of Mr. Phillips."[1] The following year Professor Hall gave the base as somewhat lower when he stated that the Devonian system appears "to correspond to the Chemung and Portage groups, and also to include a portion of the Hamilton."[2] In 1847 Professor Hall stated that

> With the Schoharie grit, commences a series of strata containing fossils as distinct from those of the preceding formations, as these are from the lower division. We here, for the first time, recognize several species that are regarded as Devonian forms; and if zoölogical characters are to be paramount, we are compelled to unite all the succeeding strata as of Devonian age.[3]

Finally in 1859, he raised the question whether even the Oriskany sandstone might not be considered as of Devonian age. For he wrote as follows concerning

> the line of demarkation for the Silurian and Devonian systems. Shall the advent of the Oriskany sandstone, with its *Spirifer* of dichotomizing costæ,be the division? Or shall we look for some more marked and more readily defined and recognized feature for the distinction between what are regarded as two great geological systems?[4]

So far as the writer is aware, de Verneuil in 1847 was the first geologist definitely to correlate the younger formations of the New York system with subdivisions of the Devonian system of Europe. He made the base of the Oriskany sandstone the dividing line between the Devonian and Silurian systems;[5] correlated the Hamilton, Tully, Genesee, Portage, and Chemung with the formations of the Eifél and Devonshire, and the Marcellus with the shales of Wissenbach in Nassau, as is proved by their Goniatites, so analogous in form.[6]

In recent years several geologists have considered the correlation of the American Mesodevonian with European rocks of equivalent age, of which the following are the most important:

[1] *Geology of New York*, Part III, p. 171.

[2] *Ibid.*, Part IV, p. 20.

[3] *Palæontology of New York*, Vol. I, p. xvii.

[4] *Ibid.*, Vol. III, Part I, p. 42.

[5] *Bulletin de la Société Géologique de France*, Second Series, Vol. IV, p. 677; also *American Journal of Science*, Second Series, Vol. V (1848), p. 367, on the parallelism of the Palæozoic deposits of North America with those of Europe, translated by JAMES HALL.

[6] *Loc. cit.*, p. 678; and *American Journal of Science, loc. cit.*, pp. 367, 368.

In 1889 Professor H. S. Williams apparently correlated in a general way the American Middle Devonian with "the Ilfracombe [England] beds of Phillips, the Givétien limestone of Belgium, [and] the Stringocephalien shales or limestones of the Eifél and Hartz regions."[1] In 1888 Professor Williams examined in the field typical sections of the Devonian rocks of Devonshire, England, and later stated that "it appears probable that the limestones of South Devonshire represent the general interval between the close of our Corniferous [Onondaga] and the early part of our Chemung formation."[2] Professor Renevier in 1896 classed the Hamilton flags and Marcellus shales together and regarded them as having been deposited during the same general period of time as the *Tentaculite* slates (lower part) of Thuringia, Hesse, Nassau, and Bohemia; the Wissenbach or *Orthoceras* slates of Nassau; the Lenne slates (in part) of southern Westphalia; and the schists with *Phacops potieri* of Brittany; all of which were correlated with the Couvinien age or stage, which he gave as the lower one of the Middle Devonian or Eifélien epoch or series.[3]

Dr. Frech draws the line between the Paleodevonic and the Mesodevonic of New York at the top of the upper Oriskany sandstone, and considers the Mesodevonic as composed of the Ulsterian and Erian seris, in the latter of which are the Marcellus shales, Hamilton beds, and *Stringocephalus* beds of Canada.[4] At an earlier date Dr. Frech, in his summary of the important occurrences of the Devonian, gave the Marcellus shale and Hamilton group as forming the upper part of the Middle Devonian, and correlated them as beginning in the time of the upper part of the *Calceola sandalina* stage and continuing through that of the *Stringocephalus burtini* of Rheinland.[5] In this same table the Marcellus and Hamilton considered together are correlated with the upper part of the Eifélien (*Calceola* shales

[1] *Compte rendu*, Fourth Session, International Geological Congress (London, 1888), 1891, Appendix A, p. 142; also issued as *Report of the Sub-Committee on the Upper Paleozoic* (*Devonic*), by H. S. WILLIAMS, C, 1889, p. 22.

[2] *American Journal of Science*, Third Series, Vol. XXXIX (1890), p. 36.

[3] *Chronographe géologique*, 2d ed. of *Tableaux des terrains sedimentaires; Compte rendu*, Sixth Session, International Geological Congress (Zurich, August, 1894); Lausanne, March, 1897).

[4] *Lethaea geognostica*, I, *Lethaea palaeozoica*, Vol. II, Part IV (1902), p. 690.

[5] *Ibid.*, Vol. II, Part I (1897), Table XIX, opposite p. 256.

of Couvin) together with the entire Givétien (which is composed in ascending order of the red sandstone and conglomerate of Vicht and *Stringocephalus* limestone of Givét) of Belgium; while they are given as equivalent in England to the Ilfracombe beds, with probably additional ones below and above, of North Devon; and to the upper part of the *Calceola* shales of Hopes Nose and Ogwell House, succeeded by the diabase and scale stone of the Ashfrington series and the *Stringocephalus* limestone of South Devon.

In another part of the work Dr. Frech, in comparing the North American and Rhenish Devonian, said:

> In the Corniferous [Onondaga] limestones the faunal diversity is less sharply defined than in the lower formations; but in this case, as in the higher Hamilton group, still distinctly perceptible. The latter is often developed in the form of sandy marl and calcareous sand, and the peculiar faunal similarity with the Rhenish Lower Devonian partly rests upon this harmony in facies. But, on the other hand, the marl (Moscow shale), for example, where it forms on Cayuga Lake the greater part of the Hamilton, has a perfect agreement in facies with the *Calceola* marl, and likewise the Encrinal limestone reminds one of a similar interstratified limestone. . . . . The fauna of the American Middle Devonian, whose chief representatives the Hamilton group contains, is, notwithstanding some corresponding features, yet, on the whole, so different that one must assume the existence of a special sea province also in Middle Devonian time differing from the Rhenish.[1]

Finally, at the close of this section is the statement that the Marcellus shale corresponds to the lower part of the stage of the *Maeneceras terebratum*[2] of Rheinland, which Dr. Frech puts in the stage of the *Stringocephalus burtini*.

De Lapparent considers the Middle Devonian of North America as composed of the Corniferous (Onondaga) limestone, Marcellus shale, and Hamilton beds.[3] The Marcellus shale he correlates with the upper part of the Eifélien stage and the lower part of the Givétien, while the Hamilton beds represent the remaining and greater part of the latter stage. He also gave the lower Marcellus shale as representing the upper part of the shales of Ogwell House, and then the remaining portion together with the Hamilton beds as synchronous with the Ilfracombe or Plymouth beds of Devonshire, England.[4]

Professor Kayser in the table of the Devonian formations of New

[1] *Ibid.*, pp. 214, 215.
[2] *Ibid.*, p. 216.
[3] *Traité géologique*, 4th ed. (1900), p. 857.
[4] *Ibid.*, p. 869.

York, gives the Mesodevonic as composed of the Marcellus shale and Hamilton beds,[1] but in the text he says:

> The American geologists generally still classify the Onondaga limestone as Lower Devonian; according to European experience, one would be rather inclined to classify it entirely or mostly as Midddle Devonian. The great similarity of the characteristic *Spirifer acuminatus* Con. with our *S. cultrijugatus* argues for this classification.[2]

Regarding the classification of the Hamilton the professor says:

> Although the Hamilton shale locally might represent the entire Middle Devonian, yet, on the whole, it corresponds to the upper division. This is surely shown by the frequent overlying beds of the Tully limestone and Genesee shale, the first of which contians the Brachiopod fauna of our Iberg limestone (*Rhynchonella venustula* = *cuboides*, etc.).[3]

Finally, this writer has given the correlation of the Middle Devonian of Europe and North America in the following table:

RHEINLAND AND BELGIUM.		BOHEMIA.	NORTH AMERICA.
		G^3,	
Stringocephalus	Wissenbach	G^2,	Hamilton beds,
limestone,	and	G^1,	Marcellus beds,
Caleceola shales.	Lenne slates.		
		Mnenian limestone.	
			Onondaga limestone[4]

Dr. Hermann Credner gives the Middle Devonian of New York as composed in ascending order of the Upper Helderberg (Onondaga), Marcellus shale, and Hamilton sandstone, shale, and limestone. The Upper Helderberg he correlates with the Eifélien and stage of the *Calceola sandalina*, and the Marcellus and Hamilton with the Givétien and stage of the *Stringocephalus burtini*.[5]

Sir Archibald Geikie considers the Middle Devonian of New York as composed of the Marcellus and Hamilton groups,[6] while the same division in Europe he gives as composed of the Eifélien and Givétien, with which he correlates the Marcellus and Hamilton.[7]

GENERAL DISTRIBUTION OF THE MESODEVONIAN.

Rocks of the Mesodevonian age have a considerable distribution, aside from that of the eastern United States and Canada, for they

[1] *Lehrbuch der geologischen Formationskunde*, 2d ed. (1902), p. 150.
[2] *Ibid.*, p. 151. [3] *Ibid.*, p. 151. [4] *Ibid.*, p. 155.
[5] *Elemente der Geologie*, 9th ed. (1902), p. 447.
[6] *Text-Book of Geology*, 4th ed., Vol. II (1903), p. 997.
[7] *Ibid.*, "The Geological Record," opposite p. 861.

have been identified and described in Nevada; the dolomite of Manitoba contains the European species *Stringocephalus burtini; Spirifer mucronatus* has been found upon the banks of the Albany River south of Hudson Bay; the fauna of the Hamilton shales occurs in the Mackenzie Valley from the Clear Water River to the Arctic Ocean; while it is also reported from the Porcupine River, a western tributary of the Yukon in Alaska, and perhaps also on Kouiou Island, in the southern part of that territory. In South America, in Brazil, in the province of Para, in the Ereré district, are beds which Katzer refers to the base of the Middle Devonian, and Dr. J. M. Clarke has stated regarding the fauna of the Ereré sandstone that it

> is remarkably free from species or representatives of subgeneric groups prevailing elsewhere in early Devonian faunas, and equally devoid of types which elsewhere pass upward into the later faunas; in other words, it is, with all its resemblance to the Hamilton, a more typical and better-defined Middle Devonian fauna than that;[1]

while Dr. Frech reports Middle Devonian in Bolivia and Cleland from the Jachel River in Central Argentina.[2] On the eastern continent Middle Devonian rocks occur in England in northern and southern Devonshire, in northern France and southern Belgium, in the region of the Vosges, in the Central Plateau and the Montagne-Noire of France, and in the Pyrenees and Spain. In central and eastern Europe they occur in the Eifel, Rheinland (Nassau), Hartz, Thuringia, Bohemia, Galicia, Russian Poland, the Carnic Alps, and on the Bosporus. These rocks also cover a large area of eastern Russia and the western slope of the Urals, extending to the border of Finland on the north. In Asia Middle Devonian rocks occur in Siberia, China, and on the south side of the Tian-Shan Mountains in Central Asia. In Australasia they are found in New South Wales, Victoria, and Tasmania; and they also probably occur in Africa.[3]

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[1] *Archivos do Museu Nacional do Rio de Janeiro.* Vol. X (1899); author's English edition (1900), p. 90.

[2] *Bulletin No. 206,* U. S. Geological Survey, (1903) p. 19.

[3] For this account of the distribution of the Mesodevonian the writer is largely indebted to DE LAPPARENT'S *Traité de géologie,* FRECH'S *Lethaea palaeozoica,* and KAYSER'S *Lehrbuch der geologischen Formationskunde.*